

What is claimed is:

1 1. A zoom lens formed of only four lens groups arranged along an optical axis, in order from the  
2 object side, as follows:

- 3 a first lens group having positive refractive power;  
4 a second lens group having negative refractive power;  
5 a third lens group having positive refractive power; and  
6 a fourth lens group having positive refractive power;

7 wherein

8 the first lens group and the third lens group do not move during zooming;  
9 the second and fourth lens groups are moved along the optical axis during zooming;  
10 the first lens group includes, in order from the object side, a first lens element having  
11 negative refractive power, a second lens element having positive refractive power and a convex  
12 lens surface on the object side that is cemented to the first lens element, a third lens element, and a  
13 fourth lens element having positive refractive power and a convex lens surface on the object side;  
14 and

15 the following conditions are satisfied:

16 
$$v_{d1} < 45$$

17 
$$N_{d2} < 1.52$$

18 
$$v_{d2} > 63$$

19 where

20  $v_{d1}$  is the Abbe number of the first lens element of the first lens group at the d-line,

21  $N_{d2}$  is the refractive index of the second lens element of the first lens group at the d-line,

22 and

23  $v_{d2}$  is the Abbe number of the second lens element of the first lens group at the d-line.

1 2. The zoom lens of claim 1, wherein the first lens group consists of the first lens element, the  
2 second lens element, the third lens element, and the fourth lens element.

1 3. The zoom lens of claim 1, wherein the following condition is satisfied:

2 
$$6 < f_1 / f_w < 15$$

3 where

4  $f_1$  is the composite focal length of the first lens group, and

5  $f_w$  is the focal length of the entire four-group zoom lens at the wide-angle end.

1 4. The zoom lens of claim 2, wherein the following condition is satisfied:

2 
$$6 < f_1 / f_w < 15$$

3 where

4  $f_1$  is the composite focal length of the first lens group, and

5  $f_w$  is the focal length of the entire four-group zoom lens at the wide-angle end.

1 5. The zoom lens of claim 1, wherein the fourth lens group includes, in order from the object  
2 side, a first lens element having positive refractive power and a convex lens surface on the object  
3 side, a second lens element having a biconcave shape, a third lens element having positive  
4 refractive power, and a fourth lens element having positive refractive power.

1 6. The zoom lens of claim 5, wherein the fourth lens group consists of the first lens element, the  
2 second lens element, the third lens element, and the fourth lens element.

1 7. The zoom lens of claim 2, wherein the fourth lens group includes, in order from the object  
2 side, a first lens element having positive refractive power and a convex lens surface on the object  
3 side, a second lens element having a biconcave shape, a third lens element having positive  
4 refractive power, and a fourth lens element having positive refractive power.

1 8. The zoom lens of claim 7, wherein the fourth lens group consists of the first lens element, the  
2 second lens element, the third lens element, and the fourth lens element.

1 9. The zoom lens of claim 3, wherein the fourth lens group includes, in order from the object  
2 side, a first lens element having positive refractive power and a convex lens surface on the object  
3 side, a second lens element having a biconcave shape, a third lens element having positive  
4 refractive power, and a fourth lens element having positive refractive power.

1 10. The zoom lens of claim 9, wherein the fourth lens group consists of the first lens element, the  
2 second lens element, the third lens element, and the fourth lens element.

1 11. The zoom lens of claim 4, wherein the fourth lens group includes, in order from the object  
2 side, a first lens element having positive refractive power and a convex lens surface on the object  
3 side, a second lens element having a biconcave shape, a third lens element having positive  
4 refractive power, and a fourth lens element having positive refractive power.

1 12. The zoom lens of claim 11, wherein the fourth lens group consists of the first lens element,  
2 the second lens element, the third lens element, and the fourth lens element.

1 13. The zoom lens of claim 1, wherein at least one of the lens surfaces of at least one of the lens  
2 elements of at least one of the third lens group and the fourth lens group is aspheric.

1 14. The zoom lens of claim 2, wherein at least one of the lens surfaces of at least one of the lens  
2 elements of at least one of the third lens group and the fourth lens group is aspheric.

1 15. The zoom lens of claim 3, wherein at least one of the lens surfaces of at least one of the lens  
2 elements of at least one of the third lens group and the fourth lens group is aspheric.

1 16. The zoom lens of claim 4, wherein at least one of the lens surfaces of at least one of the lens  
2 elements of at least one of the third lens group and the fourth lens group is aspheric.

1     17. The zoom lens of claim 5, wherein at least one of the lens surfaces of the lens elements of the  
2     third lens group and the fourth lens group is aspheric.

1     18. The zoom lens of claim 6, wherein at least one of the lens surfaces of the lens elements of the  
2     third lens group and the fourth lens group is aspheric.

1     19. The zoom lens of claim 7, wherein at least one of the lens surfaces of the lens elements of the  
2     third lens group and the fourth lens group is aspheric.

1     20. The zoom lens of claim 8, wherein at least one of the lens surfaces of the lens elements of the  
2     third lens group and the fourth lens group is aspheric.